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# INDEX TO VOLUME XX.


A

Abbott, C. C., palæolithic man in North America, 270, 344.
Adulterants, 61.
Agassiz Club, 293.
Age of metals in Europe, 260.
Aldrich, J. M., sense of direction, 262.
Algebraic notation, 359.
Alley, R. J., modern synthetic geometry, 297.
Alphabet, ancient Libyan, 30, 94, 105, 178, 192, 262, 290.
Altakapas country, 372.
Amblystoma tigrinum, 366.
America, pre-Columbian migrations in, 285; German commemorative volume on, 54.
Amery, C. F., instinct, 300.
Ames, C. H., electric-light action on plants, 291.
Anatomists, society of, 341.
Ancient Egypt in the Light of Modern Discoveries, 41.
Animals, popular errors about wild, 155.
Antarctic exploration, 202.
Anthropology at Chicago Exposition, 31; notes and queries on, 12.
Antiquities of Yucatan, vandalism among, 365.
Apgar's Trees of Northern United States, 167.
Apteryx, Prof. Parker's studies on, 66.
Arabic geographical dictionary, 173.
Archæological delusion, 275.
Archæology 1880-1892, 267.
Archippus, flight of, 291.
Architecture as an ethnic trait, 115.
Argyll's Foundations of Society, 81.
Arizona cliff-dwellers, 269.
Art-faculty, 90.
Aryans, European origin of, 151, 165, 221; question, 340.
Ashmead, A. S., rice culture, 57; cremation of cholera corpses, 132; cows' milk in Japan, 211; cremation of cholera corpses, 213; beri-beri, 281; leprosy, 309.
Asia minor, aborigines of, 30.
Association agricultural colleges, 173; for the advancement of science, 61, 135; Rochester meeting of, 146; of weather services, 131.
Atkinson, G. F., botany at the experiment stations, 328.
Auld, R. C., The American horse, 135.
Aurora, 65, 66, 178, 374; false, 318, 346.
Auroras, *versus* thunderstorms, 221; photographs of, 236; of 1892, 323.
Azoic archæan in Northern Michigan, 355.

B

Bailey, L. H., broader botany, 48.
Bailey's Mental Arithmetic, 334.
Baldwin, J. M., volition in childhood, 286.
Ball, V., lion breeding, 34.
Barbour, E. H., rock swift, 235; Richardson's owl, 361.
Bark-beetle destroyer, 256.
Barnes, C. R., modern botany, 62.
Barometric oscillations, 5.
Barracks, communal, 228.
Basques, 60.
Basu, K., primitive fashions in India, 357.
Bates, H. H., Star 1830, Groombridge, 236.
Bauer, L. A., magnetic needle secular motion, 218.
Bauxite, Alabama, 303.
Bayard, A. F. C., English climate, 5.
Beauchamp, W. M., natural implements, 305.
Becher, F. A., psychology, 10.
Beddard's Animal Coloration, 11; Colors of Animals, 208.
Beddoe, J., primitive Russians, 244.
Beetle, broods of elm-leaf, 16, 47, 92.
Bell, A. G., teaching speech to deaf, 118.
Bell, A. M., sounds of R, 216.
Bendire's Life Histories of North American Birds, 178.
Bereman, T. A., aurora, 65.
Beri-beri, 281.
Bernard's The Apolidæ, 81.
Bessey, C. E., monstrous poppy, 249; sense of direction, 263.
Bevan, D., foot deformity, 99.
Bible, recently found fragment of, 131.
Bibliography, linguistic, 7.
Birch-tree as an ethnic landmark, 206.
Birds on nests, 99; near Hanover, N. H., 86; acorn-eating, 133; English sparrow and other, 134, 165; effects of civilization on, 183; diet of, 221; how to mount, 227; that sing in the night, 313, 343; rare, 352.
Birth-rate, 7.
Black knot, 10; 123.
Blackmar, F. W., Indian education, 147.
Bliss, C. B., multiple key, 360.
Blood, color of human, 107.
Blood-corpuscles, reticular structure of, 330.
Boas, F., growth of children, 351.
Bogue, E. E., shrinkage of leaves, 163.
Bolles, F., hectoring a hawk, 123; humming-birds' food, 318.
Bolley, H. L., potato scat, 355.
Bone, aboriginal use of, in Vermont, 202.
Bonney's Induction Coils, 334.
Book-worm in New York, 111.
Bossekop, 53.
Boston school-boys, 274.
Bostwick, A. E., residual personality, 284.
Botanical library, 241; explorations in Idaho, 311.
Botany, a broader, 48; modern, 62; industrial, 75; medical, 91; at the experiment stations, 328.
Bowser's Trigonometry, 306.
Boyle, D.
Boys, Boston school, 274.
Brain and skull correlations, 230.
Brendel, E., coleoptera, 105.
Brinton, D. G., ancient Libyan alphabet, 105; European origin of Aryans, 165; ancient Libyan alphabet, 194; Ethuscan ritual book, 212; Wright's Man and the Glacial Period, 249; Crania Ethnica Americana, 278; ancient Libyan alphabet, 290.
Broom-corn, 33.
Bruner, H. L., humming-bird's food, 291.
Burials, Mentone cave, 60.
Burrill, T. J., hybridizing, 15.

C

Caldwell, J. W., molecules and crystals, 88.
Calkins, W. W., lichenology, 12, 205.
Call, R. E., science in schools, 1; chemistry of soils, 29.
Cambridge Natural History, 40.
Campbell, J. T., aurora, 66; sense of direction, 318.
Canadian archæology, 60.
Carib tongue, 115.
Carob bean, 41.
Catamarca, antiquities of, 172.
Caucasia, 19.
Cave fauna of Kentucky, 240; dwellers of Arizona, 269.
Celts and Kymri, 115.
Ceratodus, 4.
Ceylon agriculture, 89.
Chadwick's Temperament, Disease and Health, 124.
Chambers's Encyclopædia, 12, 362.
Chapin's Land of the Cliff-Dwellers, 333.
Charlton, O. C., electricity on mountain, 177.
Chemical spelling, 247; nomenclature, 272, 291; science, 127.
Chemistry as basis of agriculture, 191.
Chief Mountain Lake, 85.
Child, localization in a, 361.
Childhood, origin of volition in, 286.
Children, growth of, 351.
Cholera corpses, cremation of, 132, 213; prevention of, 170, 193; acid prevention of, 151.
Chronology, 213.
Church's Notes and Examples in Mechanics, 138.
Civilization as influenced by race, 285.
Clark, J. E., gynandrous flower head, 207.
Clevenger, S. V., trait of Jews, 106; celestial photomicrography, 135; the brutal dove, 124; acid prevention of cholera, 151; brain and skull, 230; sleep, 277.
Clocks, ancient Japanese, 365; Turkish, 316.
Clute, W. N., humming-bird's food, 333.
Codling-moth in Oregon, 291.
Cohesion, 48.
Coleoptera, migration of, 105.
Colias, 257.
Collins, J. V., algebraic notation, 359.
Collins's International Date Line, 321.
Comstock, T. B., wild animals, 155.
Conclusions, uncertainty of, 20.
Congress for experimental psychology, 32; of criminal anthropology, 285; of experimental psychology, 288; meteorological, 341.
Conn, H. W., Brooklyn Institute Summer School, 157; isolation of rennet, 253.
Connecticut Board of Health Report, 263.
Conway's Works of Thomas Paine, 187.
Corn tassels, 97.
Cornell University, 18.
Coplin, W. M. L., foot deformity, 99.
Coptic, linguistic affinities of ancient, 285.
Cotton-seed meal, 257.
Coues, E., nomenclature, 220.
Coulter, J. M., botanical nomenclature, 146.
Cousins, J. J., weights and measures in England, 298.
Coville, F. V., flora of Death Valley, 342.
Cowell, I. C., latest glacial epoch, 302.
Cows' milk, absence of, from Japan, 211.
Cox, A. O., how to mount birds, 227.
Crane, A., ancient Mexican heraldry, 174, 261.
Crayfish attacked by leeches, 220.
Cresson, H. T., graphic system of Mayas, 25; Maya day-signs 77; Maya graphic system, 101; palæolithic man in Delaware valley, 305.
Cretacous polyzoa, 327.
Criminal anthropology congress, 285.
Crinoid Heterocrinas subcrassus, 66.
Crocker's Dynamos and Motors, 363.
Crops, fungous and insect enemies of, 32.
Cross fertilizing and hybridizing, 18.
Cummins, D. H., Texas gypsum, 353.
Cummins, W. F., sense of direction, 358.
Cuneiform tablet at Tel Hesy, 145.
Currents, ocean, 19.
Cyprus, Ohnefalsch-Richter's work in, 268.

D

Dall, W. H., Grand Gulf formation, 164, 319.
Davis, W. M., profile of bad-land divides, 245.
Davis's Algebra, 293.
Deaf, progress in teaching speech to, 118.
Death Valley flora, 342.
Decimal Association, 47.
Deer, flathead, 87.
Dennis, W., watching a snake, 338.
Derby, O. A., Santa Catharina Meteorite, 254.
Diamonds in meteorites, 15.
Dictionary of Medicine, 81.
Diseases, immunity from, 356; infectious, 225.
Dixon, E. T., hypotheses in dynamics, 149.
Dixon's Migration of Birds, 39.
Dobbin and Walker's Chemical Theory, 320.
Dog, jealousy of a, 305.
Doran, E. W., phylogeny of mole cricket, 214.
Dorsey, J. O., Maltunne Tunne measures, 194; Omaha arrow measures, 194.
Douglass, A. E., rain in Peru, 231.
Dove, the brutal, 124.
Duck Islands, 184.
Dumble, E. T., flight of archippus, 291.
Dyche, D. T. D., Heterocrinus subcrassus, 66.
Dynamics, fundamental hypotheses of, 71, 122, 149, 150, 262.

E

Eames, R., growth of gold, 259.
Earle, Charles, variability of specific characters, 7.
Educational, standards in professional, 92.
Edwards's Coals and Cokes in West Virginia, 376.
Eells, M., twins among Indians, 192.
Egypt, Flinders-Petries work in, 267.
Egyptian and Semitic languages, 131.
Eigenmann, C. H., Percopidæ on Pacific slope, 233.
El Graa Chaco, 232.
Electric phenomena on mountain, 177; light, action of, on plants, 291; phenomena on mountains, 318, 359.
Ellis, W., temperature at Greenwich, 5.
Elrod, M. J., reflex action in turtles, 368.
Elton's Career of Columbus, 173.
Emery, F. E., soil moisture, 31.
Engel, H., infectious diseases, 225.
English climate, 5.
Ensilage, 47.
Entomological types, 244.
Eskimos, 340.
Ethnic osteology, failure in, 148.
Ethnography, meaning of, 91.
Ethnology as philosophy, 60.
Etruscan ritual book, 173, 212.
Evolution, laws of human, 232.
Exhibition, geographical, 19.
Eyes of insects, 314.

F

Face, study of the, 7.
Farnsworth, P. J., Great Lake basins, 74.
Feeling, introspective study of, 203.
Fernald, H. T., crayfish attacked by leeches, 220.
Ferree, Barr, architecture as an ethnic trait, 115.
Ferree's Comparative Architecture, 361.
Fessenden, R. A., cohesion, 48.
Figurines of stone age, 260.
Finns, the, 173.
Flora of Death Valley, 342.
Flower farming, 4.
Flower-head, gynandrous, 207.
Flower's The Horse, 237.
Fog like lake, 187.
Food exhibition, 18, 201; vegetable acids in, 229.
Foot deformity from shoes, 99.
Forel's Le Léman, 355.
Forest tree Scolytid, 64.
Forests of New Hampshire, 340.
Formosa, 47.
Foster's Physiology, 68.
Freeman's History of Sicily, 81.
French, G. H., nomenclature, 151.
Fu-sang, 148.

G

Gage's Microscope and Histology, 89.
Galton, F., Boston school-boys, 274.
Galvanometer, ballistic, 361.
Gardiner, J., Thomson's Zoölogy, 232.
Garman, H., cave fauna of Kentucky, 240.
Garman S., reptilian rattle, 16.
Garner's Speech of Monkeys, 221.
Gay Head, 176, 332, 373
Geographical names, 136.

Geological expedition of University of Nebraska, 47; Society of America, 341; survey of Indiana report, 321; survey of New Jersey, 67; of Missouri, 355.
Geometry, modern synthetic, 297; non-Euclidean, 370.
Gerland's Atlas of Ethnography, 206.
German association of science, 103.
Gibbs, M., acorn-eating birds, 133; bird on nest, 99; birds that sing in the night, 313; effects of civilization on birds, 183; humming-birds' food, 239.
Gifford, J., Altakapas country, 372; introduction of foreign species, 304; yeasts, 249.
Gila monster, 319.
Glaciation in Montana, 162.
Glacial epoch, date of latest, 302; theories, 360.
Glycerine, solid, 263, 278.
Gnat-bites, 215.
Gold, growth of, 259.
Gore's Geodesy, 375; Visible Universe, 333.
Grand Gulf formation, 151, 164, 247, 319.
Grape leaves, 39.
Great Lake basins, 74.
Green Mountains' anticlinal, 328
Grinnell, G. B., Chief Mountain L
Grippe, 152.
Griswold's Whetstones and Novaculitea of Arkansas, 107.
Gypsum, Texas, 353.

H

Hainan, 19.
Hair, study of, 260.
Hall, J. N., sense of direction, 113.
Hall, J. P., photographs of auroras, 236.
Hamilton, H., prevention of cholera, 170, 193.
Hann, J., barometric oscillations, 5.
Harding, L. A., forensic microscopy, 242.
Hargitt, C. W., Amphiuma means, 159.
Harisse's Discovery of North America, 39.
Harvey, case-hardening, 75.
Hatch's Mineralogy, 137.
Hatch, P. L., false aurora, 318.
Hawk, hectoring a, 123.
Hay, O. P., biological papers, 243.
Hazen, H. A., Moon and rainfall, 310; electric phenomena on mountains, 359.
Heath, A., collas, 257
Hemiptera, etc., 52.
Hempel's Gas Analysis, 293.
Henderson, C. R., woman's work for wages, 190.
Heraldry, ancient Mexican, 174, 261.
Heredity, 190.
Hioen's Metal Coloring, 363.
Hirn, monument to, 18.
Hitchcock, A. S., botanical library, 241.
Hitchcock, C. H., Green Mountains' anticlinal, 328.
Hitchcock, R., photographic laboratory, 160; pre-Aino race in Japan, 163.
Hobbs, W. H., hornblende and augite, 354.
Hodge, F. Webb, Journal of American Ethnology, 152.
Hoffmann's Sloyd System of Wood-Working, 363.
Holbrook, M. L., human blood, 107; la grippe, 152.
Holbrook's Treatment of Consumption, 264.
Holder's Florida Reef, 215.
Holmes, W. H., quarry refuse, 295.
Hopkins, A. D., forest-tree Scolytid, 64.
Hornblende and augite, 354.
Horse, intelligence of a, 133; American 135, 188; feeding of, 4.
Hoskins, L. M., hypotheses of dynamics, 122.
Houston, E. J., weather in Mars, 86.
Howe, J. L., extinction of mulatto, 375.
Hudson's Naturalist in La Plata, 136.
Human remains discovered near Mentone, 170.
Humming-birds' food, 239, 291, 318, 333.
Hunter-Duvar's Stone, Bronze, and Iron Ages, 39.
Huntington, O. W., diamonds in meteorites, 15.
Hussey, W. J., lines on Mars, 235.
Hyatt, J., aurora, 374.
Hybridism exemplified in the genus colaptes, 325.

I

Ice, impurity of, 141.
India, primitive fashions in, 357.
Indian numerals, 9; types of beauty, 115.
Indians, census of, 31.
Influenza, 103.
Ink stains, 346.
Implements, natural, 305.
Instinct, 300.
Intelligence of lower orders, 345.
Introduction of foreign species, 304.
Inventors' academy of Paris, 186.
Irrigation reports, 346.

J

Jackals, 33.
Jackman's Nature Study, 293.
James J. F., geological survey of New Jersey, 67; wheat rust and smut, 93; Merrill's Geognosy, 94; bird reports, 178; destroying mosquitoes, 247; irrigation reports, 346; agricultural reports, 361.
James's Alaskana, 292.
Jamieson's Applied Mechanics, 375.
Japan, pre-Aino race in, 148, 163.
Jealousy in infants, 248; of a dog, 305.
Jews, a trait of, 106.
Johnson, L. C., Grand Gulf formation, 151, 247.
Jones, M. E., gila monster, 319.
Jones, R. W., rattlesnake, 277.
Jordan, D. S., Hopkins seaside laboratory, 76.
Journal of American Ethnology, 152.

K

Kangaroo in America, 82.
Kansas Academy of Science, 250.
Keane, A. H., ancient Libyan alphabet, 178, 262.
Keely's In Arctic Seas, 173.
Kempton, C. W., Mars, 152; meteoric shower, 333; snake eats snake, 107.
Kent, W., Rochester Meeting, A. A. A. S., 135.
Key, a multiple, 360.
King, F. H., ensilage, 47.
King, T. G., an archæological delusion, 275.
Kirby, W. F., entomological types, 244; Saturniidæ, 246.
Kirby's Entomology, 194.

L

Laboratory, Hopkins seaside, 77; teaching, 53, 207; of plant diseases, 368.
Laing's Human Origins, 109.
Lamentable case, 291.
Land, our waste, 327.
Lane, A. C., optical angle and angular aperture, 354.
Langley's Energy and Vision, 362.
Language, universal, 232.
Languages, bibliography of American, 340; central American, 172.
Larkin, E, L., Mars, 17; aurora, 65; meteoric shower, 346.
Leaves, shrinkage of, 163.
Left-handedness, 60.
Leland's Etruscan-Roman Remains in Popular Tradition, 334.
Lepél, V., oxidation of nitrogen, 33.
Leprosy, immunity from, 309.
Leverett, Frank, ice-sheet in Ohio, 103.
Lewis, R. T., eyes of insects, 314.
Lewis and Clarke's Expedition over the Rocky Mountains, 173.
Library of Prof. L. Just, 12.
Lichenology, 120, 205.
Light rays of small wave-length, 216.
Ligurians, Iberians, and Siculi, 90.
Linebarger, C. E., solutions, 352.
Linguistics as a physical science, 206.
Lion breeding, 34.
Liveing, G. D., liquid oxygen, 169.
Lobsters for New Zealand, 341.
Lock's Mechanics for Beginners, 139.
Loew, P., immunity from disease, 356.
Lupton, A., spontaneous combustion in mines, 299.
Luschan, F. von, aborigines of Asia Minor, 31.
Lydekker's Phases of Animal Life, 95.

M

Mabery, C. F., laboratory teaching, 207.
McCalley, Alabama bauxite, 303.
McCallie, S. W., mastodon in Tennessee, 333.
McCarthy, G., weeds, 38.
MacDonald, A., 32; congress of psychology, 288.
MacDougall, D. T., botanical explorations in Idaho, 311.
McFarland, R. W., chronology, 213.
McGee, W. J., man and the glacial period, 317.
MacGregor, J. G., dynamics, 71, 150, 262.
McLean's Indians of Canada, 110.
MacRitchie, D., a Pict's house, 43.
Magnetic circuit, 258; needle, secular motion of a, 218.
Magnus's Elementary Mechanics, 375.
Male and female, anatomical criterion for, 173.
Malley, A. C., reticulated protoplasm, 261.
Mammoth in Siberia, 201.
Man and the glacial period, 275, 317, 360, 270, 295, 304, 344; primitive history of, 90; primitive, in South America, 147.
Mars, 152; lines on, 177, 282, 235; opposition of, 17; weather in, 86.
Martin, D. S., A. A. A. S. meeting, 146.
Mason, W. P., laboratory teaching, 53; weights and measures, 358.
Mastodon in Tennessee, 333.
Mather, F., sense of direction, 248.
Maya chronology, 80; day-signs, 77; graphic system, 25, 101, 121, 197, 41; language, study of, 6.
Maxwell, C. P., satellite of Moon, 66.
Mechanical Engineering Teachers' Association, 32.
Medical Association, Miss. Valley, 5.
Meehan, T., cleistogamy in pansy, 107; black knot, 123.
Mendenhall, T, C., uncertainty of conclusions, 20.
Mengel, L. W., Duck Islands, 184.
Merrill, G. P., box for microscope slides, 298.
Merrill's Geognosy, 94.
Merriman, M., Moon and rainfall, 310.
Merriman's Geodetic Surveying, 375.
Merz's Influenza, 125.
Meteor, brilliant, 346.
Meteoric shower, 333, 346.
Meteorite, is Sao Francisco do Sul iron a, 254.
Meyer's Outlines of Theoretical Chemistry, 108.
Mice in Thessaly, 104.
Michener, C., botanic trinomial, 245.
Michigan Mining School, 145, 234.
Microscope slides, box for, 298.
Microscopy, forensic, 242.
Migrations in America, pre-Columbian, 285.
Milk, aeration of 156.
Miller, G. A., non-Euclidean geometry, 370.
Millspaugh, C. F., weeds, 61; medical botany, 91.
Milne's Standard Arithmetic, 293.
Mines, spontaneous combustion in, 299.
Mining statistics, 335.
Mississippi River, 314.
Mole cricket, phylogeny of, 214.
Molecules and crystals, 88.
Mollusca, Ward's collection of, 369.
Mont Blanc observatory, 5.
Montgomery, H., science in schools, 142.
Montmahon and Beauregard's Zoölogy, 320.
Moon satellite, 66.
Moorehead's Primitive Man in Ohio, 195.
Morris's Physical Education, 265.
Morse, E. S., 19; roofing tiles, 115; a pre-Aino race in Japan, 148.
Mosquitoes killed by kerosene, 247.
Mother and Child, 327.
Mound, Serpent, 275.
Mounds, builders of southern, 261.
Mouse, pocket, 357.
Mulatto, extinction of, 375.

N

Nadaillac, Marquis de, discoveries near Mentone, 170.
Nadaillac's Manners and Monuments of Prehistoric Peoples, 291.
Nahuatl language, 31
Naltunne Tunne measures, 194.
National museum publications, 106.
Nervous diseases in low races, 339, 373.
New York Academy of Science, biological section, 257.
New Zealand, biological notes from, 323.
Niedlinger, C., animal phosphorescence, 207.
Nitrogen, oxidation of, 33.
Nomenclature, 164, 219, 245, 263; in botany, 146; priority, 116; question, 151.
Norton, T. H., chemical nomenclature, 272, 291.
Numerals, Indian, 9.
Nutting, C. C., Beddard's Colors of Animals, 208.

O

Oil on troubled waters, 47.
Omaha arrow measures, 194.
Optical angle and angular aperture, 354.
Oriental Review, 377; subjects, need of instruction in, 359.
Orientation of primitive structures, 6.
Ornithologists' Union, 243.
Osborn, H. L., Amblystoma trigrinum, 366.
Osteological notes, 46.
Owl, Richardson's, in Nebraska, 361.
Oxygen, liquid, 169.

P

Palenque tablet, 38, 80.
Palestine, 75.
Palmer, C. B., Florida pitcher plant, 171.
Pansy, cleistogamy in, 107.
Parker, W. T., misuse of quinine, 155.
Parker, H. W., lines of Mars, 282.
Parker's Elementary Biology, 81.
Patterson, H. J., vegetable acids in food, 229.
Peal, S. E., communal barracks, 228.
Peddie's Physics, 376.
Peirce's Critic of Arguments, 173.
Percopidæ on Pacific slope, 233.
Perkins, G. H., aboriginal use of bone in Vermont, 202.
Persian-English Dictionary, 82.
Personality, residual, 284.
Peru, rain in southern, 231.
Peruvian languages, 6.
Petroleum in Caucasus, 145.
Phosphorescence, animal, 207.
Photographic laboratory, 160.
Photomicrography, celestial, 135.
Pickering, E. C., large southern telescope, 193.
Picts' houses, 43.
Pictures for projection, 313.
Pile-structure, an aboriginal, 91.
Pilling, J. C., linguistic bibliographies, 7.
Pilling's bibliographies, 340.
Pilsbury, H. A., Ward's collection of mollusca, 369.
Plant, Florida pitcher, 171; disease reports, 361.
Plants of Michigan, 83.
Platt, C., impurity of ice, 141; solid glycerine, 278.
Plumb, C. S., aeration of milk, 156.
Political science school, 201.
Polynesian society, 32; ethnology, 340.
Pope's Electric Telegraph, 355.
Poppy, monstrous, 249.
Posse's School Gymnastics, 209.
Post, A. H., ethnology, 60.
Potato scab, 355.
Prescott, A. B., chemical science, 127.
Prize, Alvarenga, 313.
Profile, convex, of bad-land divides, 245.
Prosopology, 7.
Protoplasm, reticulated, 161. 261, 374.
Psychological association, 104; congress, 288; laboratory at Yale, 324.
Psychology, plea for study of, 10.
Punishment, origin of, 233.

Q

Quarry-rejects, 260.
Questions and Answers in Electricity, 363.
Quinine, popular misuse of, 155.

R

R, sounds of, 217.
Race and culture, 147.
Rainfall and Moon, 310.
Rattle, reptilian, 16.
Rattlesnake, 277; in captivity, 345.
Raymond's Atmospheric Pressure, 321.
Redding, T. B., intelligence of a horse, 133.
Rennet, isolation of, 253.
Respiratory movements, action of drugs on, 316.

Rhoads, S. N., hybridism in colaptes, 325.
Rice culture from a hygienic point of view, 57.
Ridgway, R., birds that sing at night, 343.
Ridgway's Humming Birds, 178.
Riley, C. V., broods of elm-leaf beetle, 16.
Rivista di patologia vegetale, 46.
Rockwell, A. D., nervous diseases, 373.
Romanes's Darwin and after Darwin, 109.
Roofing tiles, 115.
Rothrock, J. T., our waste land, 327.
Rowlee, W. W., germination of seeds, 189.
Ruffner, W. H., English sparrow, 165.
Russell's Electric Light Cables, 333.
Russian surveys, 61.
Russians, primitive, 244.

S

St. Gervais disaster, 89.
Salamander, a, 366.
Salt in sea-water, 258.
Sampson, F. A., English sparrow, 80.
Sanborn, J. W., feeding horses, 4; spiders' food, 344.
Saturnlidæ, 246.
Saville, M. H., vandalism among antiquities, 365.
Scents, 233.
Schäfer's Essentials of Histology, 39.
Schaufuss, C. F., Clerus formicarius L., 256.
Schlegel, G., Fu-Sang, 148.
School, Summer, of Brooklyn Institute, 157; science in high, 1; proposed changes in studies in, 341.
Schumann, V., light of small wave length, 216.
Science in high schools, 1;. in schools, 142; teachers from Michigan normal school, 185.
Scientific Roll, 349.
Sclavic skulls, 285.
Scott's Chemical Theory, 321.
Scripture, E. W., localization in a child, 361; ballistic galvanometer, 361.
Seeds, facilitated germination of, 189.
Seeley, F. A., Turkish time-pieces, 316.
Seler, E., Palenque tablet, 38; Maya chronology, 80; Maya graphic system, 121.
Sense of direction, 113, 207, 248, 262, 291, 318, 358.
Sexton's Deafness and Discharge of the Ear, 109.
Shufeldt, R. W., Beddard's Animal Coloration, 11; apteryx, 66; National Museum publications, 106; Indian tyyes of beauty, 115; vernacular name of the genus harporhynchus, 333.
Shutt, F. T., agricultural chemistry, 191.
Skeel, F. D., Japanese clocks, 365.
Skulls, shape of Sclavic, 285.
Slade, D. D., osteological notes, 46.
Slater, J. W., scents, 233.
Slater, W., diet of birds, 221.
Slavic archæology, 276.
Sleep, preliminary note on, 277.
Smelling, science of, 215.
Smith, C. C., solid glycerine, 263.
Smith. J. B., elm-leaf beetle, 92.
Smith and Kellar's Experiments in General Chemistry, 292.
Smith's Geology of Alabama, 377.
Smithsonian Institution Report, 165.
Snake eats snake, 107; Congo, 159; bite, 255; watching a, 338,
Snell, M. S., oriental subjects, 359.
Soil moisture, 31.
Soils, chemistry of, 29.
Solutions, 352.
Southwick, E. B , local hemiptera, 52.
Sparrow, English, 79.
Species, introduction of foreign, 304.
Spencer, B , ceratodus, 4.
Spiders' food, 344.
Spon's Tables for Engineers, 362.
Stanley, H. M., tornado whirls, 124; feeling, 203; markings of Mars, 235.
Star 1830 Groombridge, 236.
Starry realms, 11.
Stars, real motions of, 192.
Stature from length of long bones, 206.
Steinen, K. von den, Carib tongue, 115.
Steinmetz, C. P., magnetic circuit, 258.
Stephens, F., pocket mouse, 351.
Stevenson, A., jealousy in infants, 248.
Stevenson, S. Y., archæology, 1880–1892, 267.
Stine, W. M , aurora, 178.
Stokes, A. C., reticulated protoplasm, 161; blood-corpuscles, 330; protoplasm, 374.
Stone, G. H., electric phenomena on Mountains, 318.
Strode, J. B., heredity, 190.
Strong, E. A., science teachers, 185.
Sumero-Akkadian question, 75.
Swallow, C. W., rare birds, 352.
Swan, R. M., Zimbabwe, 6.
Swift, L., aururæ of, 1892. 323.
Swift, black-throated rock, 235.
Syme's Modication of Organisms, 81.

T

Taussig's Tariff History, 173.
Taylor, I., origin of Aryans, 151; European origin of Aryans, 221; letter Y, 300.
Telephone, long-distance, 229.
Telescope, large southern, 193.
Temperature at Greenwich, 5.
Thomas, C., Maya hieroglyphics, 44; Palenque tablet, 80.
Thompson, A. H., the face, 7.
Thomson, G. M., biological notes from New Zealand, 323.
Thomson's Outlines of Zoölogy, 222.
Thorne's Diphtheria, 68.
Thrasher or Thresher, 333.
Tillman's Lessons in Heat, 139.
Toads, blood from eyes of, 243.
Todas, the, 5.
Tompkins's Woodworker's Manual, 377.
Tooth culture, 55.
Topinard, Prof., Celts and Kymri, 115.
Tornado-whirls in clouds, 124.
Tourney, J. W., cliff-dwellers in Arizona, 269.
Townsend, C. H. T., nomenclature, 164.
Tree-line in Europe, 19.
Trouessart, E. L., American horse, 188.
Trowbridge, W. P., 102.
Tucker, W. G., purification of water, 34.
Tupaia javanensis, 5.
Turner, C. H., grape leaves, 9.
Turtles, reflex action in, 368.
Twins among Indians, 192.

U

Uhler, P. R., Gay Head, 176; 373.
Underwood, L. M., nomenclature, 116.
University extension monographs, 39.

V

Vandalism among antiquities of Yucatan, 365.
Van Deman, H. E., sense of direction, 291.
Vans, ancient, 232.
Variability of specific characters, 7.
Vasey's grasses of the Pacific Slope, 361.
Veeder, M. A., auroras and thunder storms, 221,
Verity's Electricity up to Date, 335.
Vine, G. R., cretaceous polyzoa, 327.
Virchow's Crania Ethnica Americana, 278.
Vocabularies, comparative, 147.
Volition in childhood, 286.

W

Wadsworth, M. E., azoic archæan in northern Michigan, 355.
Warring, C. B., Mars, 177.
Washburn, F. L., coddling-moth in Oregon, 291.
Wasp study, 220.
Water, chemical purification of, 34.
Weed, C. M., birds at Hanover, 86.
Weeds, American, 38; list of, 61.
Weed's Spraying Crops, 69.
Weights and measures, confusion in, 358; in England, 298.
Weismann's Essays on Heredity, 109.
Well, breathing, 337.
Wheat rust and smut, 93; in Indiana, 159.
White, D., Gay Head, 332.
Whiteley's Chemical Calculations, 138.
Whiting, H. L., Mississippi River, 314.
Whiton, A. M., ink stains, 346.
Willard, J. T., a breathing well, 337.
Williams, J. B , rattlesnake, 345.
Williams, W. M., salt in sea-water, 258.
Williamson, A. W., motions of stars, 192.
Williams's Geological Map of Baltimore, 355.
Williams's History of Modern Education, 125.
Williams's Systems of Ethics, 335.
Williston, S. W., nomenclature, 263.
Wilson, E. F., Indian numerals, 9.
Wilson, Sir D., left-handedness, 60.
Wilson's The Lost Atlantis, 265.
Windt's Siberia as It Is, 81.
Woman's work for wages, 190.
Wood, De V., science of smelling, 215.
Wood, H. C., action of drugs on respiratory movements, 326.
Wood, H. R., glaciation in Montana, 162.
Woodpeckers, American, 325.
Wood's Light, 138.
Woodworth, C. W., laboratory of plant diseases, 368.
Wooster, W. H., snake-bite, 255.
Work, H., Sense of direction, 207.
Wright, G. F., man and the glacial period, 275; glacial theories, 360.
Wright, J. McN., a wasp study, 220.
Wright's Man and the Glacial Period, 249.
Wright's Nature Readers, 67.

Y

Y, pedigree of letter, 300.
Year-book of scientific societies, 54.
Yeasts in North American Review, 249.
Yellow fever among Negroes, 33.

Z

Zimbabwe ruins, 6.

# SCIENCE

NEW YORK, JULY 1, 1892.

## NATURAL SCIENCE IN THE HIGH SCHOOL COURSE.

BY R. ELLSWORTH CALL.

THERE is needed no argument to demonstrate the necessity of training in science. It will be assumed that such training is recognized as essential, and that its attainment can in no manner now be dropped from the curricula of the high schools. It is proposed, therefore, to briefly discuss the theme under (1) Comparative Educational Value, (2) Practical Character of the Information Gained, (3) The Tendencies of the Culture of the Day, and (4) Relations to University Requirements.

### Comparative Educational Value.

It appears to be a difficult matter to discuss this feature of the proposed theme without the bias that comes either from one's own training or one's taste. Something must be conceded from either standpoint; but concession is difficult and especially so when demanded on the basis of culture value. Rather, then, than on individual opinion must estimation of comparative value be based on culture results. But what constitutes culture? Is it ability to master in ordinary array numerous facts, devise and defend delightful theories, display extended and intimate acquaintance with art, history, or song? Is it held to consist in deep research into lifeless tongues, effete philosophies, degenerate religions? Shall it rest in useful citizenship, productive thought, inventive genius, polished rhetoric, political leadership? These one and all enter into the various conceptions of culture, and these all demand a hearing. Shall they be heard? And how?

I take it that the prime factor in any educational system lies in its power to discipline. The numerous facts which the young person gains during the brief period of four years in the best high schools represent but a very small portion of the sum that marks human attainment. Not the facts, nor their class alone, give the chief feature that is valuable in school life. The collation of facts from observation, their orderly and systematic arrangement, their intelligent discussion, their applicability to the circumstances of the individual by way of amelioration, their power to draw out and direct the best side of the mind, this is discipline. But is not this also applied science? Of such discipline the self is the end. It is not culture for a vocation, for professional training, nor is it culture for an end. It is discipline as a means.

It will be conceded, I presume, that all kinds of culture have not an equally important bearing on every line of activity in life; there is, or should be, occasion for discrimination and choice. Culture, or, if one please, discipline, ought to conform to this natural principle of selection. As a matter of fact and of experience it is found that a student usually accomplishes but little till a definite and settled purpose presides over his movements, or over his intellectual tendencies. The energies of youth are limited, naturally. To save from waste time, which has to a young man quite as much value as effort, practical definiteness should be given to scholastic education. To this end, I believe, that selection of those practical or professional activities, which alone have been deemed most effective in conserving, importing, and transmitting the civilization of any age, should be singled out for school work. In this elective sense, and in this sense alone, every age has taught what it knew and taught all it knew. In former days the physical sciences were not taught because they were not known; they are taught now because they are known. A proper interpretation of the historic facts, therefore, assigns to the physical sciences, in their phenomenal and empirical aspects, a place in the foreground.

As a means of purely mental training I am disposed to accord the first place to physical science. There is involved more than a suggestion of mathematics, more than mere ability to frame correct sentences, more than memoriter exercises respecting isolated facts. Physical science means, if it mean aught, extended application of mathematical data and methods, statement of facts in other than sentential relations, the discovery — whether for the first time it matters not — of underlying laws. This is culture of the very broadest nature; this means ability to generalize; this constitutes the first stage in a successful intellectual career. I do not believe that one who is abundantly able to develop Sturm's Theorem, trace all the wanderings of the heroes of the Odyssey or the Æneid, outline the journeys of Paul in Asia Minor, or discover meanings in the "Taming of the Shrew," of which its great author never dreamed, can compete in intellectual vigor with the lad able to determine the constitution of a compound substance, decide correctly the affinities of a noxious, stranger plant, or to read facts older than the pyramid of Cheops in a scratched pebble found at the schoolhouse door. The one reads fictions long bereft of true educational value; the other deals with the facts of our daily lives. The one lives and thinks with an ancient, stranger people; the other breathes an atmosphere of intellectual activity and intellectual endeavor. The one deals with symbols — with words as various in significance as are different the minds that use them; the other with laws, unchanging, necessary, logical. The one taught by novelists, dramatists, and poets whose function it is to create imaginary worlds, dwells in an ideal world constructed to suit himself; the other lives in the midst of things of practical accomplishment. It seems to me, therefore, that this difference in the mental aptitudes of students trained side by side, one trained in science, the other in a literature in which even the masterpieces of scientific writing find no place, will stand equally well for the probable values of their influence in after years in determining the current of events.

I would have, then, a still more extended pursuit of physical science in the high school. By this it is not meant that the additional work be in the line of new subjects, but that the time now devoted to *belles lettres* and ancient languages be curtailed; that the time thus gained be given, not to new subjects, but to the more extended prosecution of the few. The point sought to be enforced is that two or three subjects in science, involving observation, technic, and reflection, as botany or physics, zoology or chemistry, be prosecuted for

very much longer periods. The business of the high school is to train, to develop, to direct, not to give encyclopædic information nor to render the student an intellectual automaton. Its great aim is to awaken thought, not as an end but as a means. Divorce such awakening from the rhetoric of pure philosophy, from the generalities of literature, from the dicta of questionable schemes. Join it to the exact methods involved in scientific research — whether original or in the lines laid down by another matters little; wed it to demonstration of natural law — whether before known is unimportant; weld it indissolubly to those mental processes which involve the most intelligent ratiocination, and the high school curriculum has attained its maximum educational value. But this assumes increased attention to and prosecution of pure science, and in this, we believe, lies the best and greatest educational power.

### Practical Character of the Information Gained.

Ten years ago, the English physicist, Professor Sylvanus P. Thompson, wrote the following: "And ought we, then, to be surprised if, in pursuance of the system we have deliberately marked out for the rising generation, we keep our future artisans, till they are fifteen or sixteen, employed at no other work than sitting at a desk to follow, pen in hand, the literary course of studies of our educational code, we discover that, on arriving at that age, they have lost the taste for manual work, and prefer to starve on a threadbare pittance as clerks or bookkeepers rather than gain a livelihood by the less exacting and more remunerative labor of their hands?" True it is that this remark was volunteered in defense of a proposed scheme for technical training — a scheme, the necessity of which is self-evident even in this country, as is witnessed by the establishment of numerous manual training schools. But this does not dull its edge nor blunt its point. The ordinary training in the high school is not suited to the demands of practical living.

It is idle, perhaps, to volunteer the remark that this is a wonderfully practical age and this great West a model of practical life. The conditions that make the environment here are not met by the ordinary scholasticism of the mother East. We can scarce do less, then, than recognize that the high school stands as the expression of the educational needs of a community. Those needs are limited or determined by the multitudinous business interests involved, and, though these be legion, sound economic theory and sound educational science alike demand their recognition in the various schemes of study. Such recognition has not always been accorded, and the small percentage of high school graduates stands somewhat in the attitude of menace to their perpetuity.

The boy or girl who is skilled in the necessary technic of the physical or chemical laboratory has become a most useful member of the community. There are no secrets that are unsearchable, no mysteries intangible, no hopeless intellectual dabbling possible in the laboratory. Principles, system, painstaking manipulation rule therein, and they are necessary. To the one versed only in the arts of literature, the relations and significance of coulombs and atomic weights, of farads and valence, of amperes and reagents, are neither attractive nor necessary. But, if disciplinary value alone be sought, who shall say that intellectual training may not come as truly to him who intelligently uses a galvanometer or a burette as to him who traces his mother-tongue to its ancient stock? And if both are to be measured by manual skill, by ability to devise and to execute, to draught and to realize, who shall say that the student inducted into that truer field of investigation and deduction, implied in the proper pursuit of physical science, has not an immeasurable advantage? He has, at command, a literature limited only by the bounds imposed upon physical research, methods as variant as the students who have trod the paths before him are different, opportunities for usefulness co-extensive with the physical needs or comforts of the highest civilization.

It seems to us that the time given to physical science in the ordinary high school curriculum is far too short to reach the highest practical advantages Usually such curricula encompass the whole round of scientific endeavor. A few weeks to this, somebody's "fourteen weeks" to that, and a term to a third subject — these often without logical sequence — and the boy or girl goes forth trained in science. Did I say trained? Forsooth, the first principles have not been mastered, the technic is entirely unknown. Add to this the positive, and, it will be granted, unfortunate fact that science subjects are taught by persons themselves untaught in either the matter or spirit of science, still less the method, and the cause of comparative failure is at hand. We say comparative failure, and use the term advisedly. We use it, because never less than a year is devoted to algebra, often more, usually an equal period to geometry, and the lion's share of the time is given to language work. All the disciplinary power possible is thus given to these subjects, and those who teach them recognize that time, and time alone, is productive of fruitful results. One, who in the face of such educational fadism, would dare suggest two years of botany or of zoology, three or four years of chemistry or of physics, would surely, like Paul, be thought "beside himself." And yet this is exactly the position we seek to defend. It will be conceded, we imagine, that science has disciplinary value, that its prosecution develops a most desirable phase of mental life, that in its exacting and painstaking methods it stands without a peer; it will also be granted that among those who have traversed its inviting fields, thought and written on what they have seen and felt, there are very many who have enriched, immeasurably, the literature of their several lands; in short, it must be granted, it seems to us, that no phase of human thought exists which can be valuable for training in the high school that does not find an equally valuable counterpart in the sphere of science. The multitude of ways in which such knowledge and training may enter into every-day life, in every social condition, renders the argument of practical utility unanswerable.

The radical feature in science training lies in the assumption that even elementary education should "supply that exact and solid study of some portion of inductive knowledge," which Dr. Whewell long ago pointed out as a want in educational method. Through it education "escapes from the thralldom and illusion which reign in the world of mere words." The student's own examination and investigation of phenomena, his own conception of their relations and values, his own inferences concerning the laws he supposes to underlie the surface of things, these all constitute the practical side of his education. In this sense, it seems to us, physical science possesses a paramount value, and should be placed accordingly in a wisely adjusted scheme for study.

### The Tendencies of the Culture of the Day.

Educational systems and schemes reflect, it will be conceded, the culture tendencies prevalent during their inaugural. It cannot, however, be assumed that their arrangement has always been best, or that it has always fallen into the wisest and safest hands. The fault

lies, not in the system, perhaps, which may be good enough considered as an end, but in the personal training of those who have had these systems in charge. I think it true that educational methods and dicta are among the very last, if we except theology, to yield to the demands imposed by changing environment. To one cultured along the lines fashionable a decade ago, it becomes a difficult task to change methods and opinions that are the outgrowth of such discipline. The maintenance of courses of study that are either largely classical or mathematical means simply a system based upon methods in vogue long since. A compromise is noted, however, in those schools in which a so-called "scientific course" is provided; from this concessisn it is easy to pass to those schools whose work is largely along the lines imposed by physical science.

This modification — whether it be forced or natural is immaterial — reflects the tendencies of the thought of the day. On all sides, and in all manner of ways, increased attention is being given to physical science. The reason is not past finding out — it lies close at hand. Science enters into the home, social and mercantile life of the world to a degree never before known in the history of mind. It has builded upon a foundation broadly and well laid, because laid primarily with a just appreciation of the physical necessities of man. Those who now toil, and no longer with unrequited labor, in the laboratories of the world have felt and still feel the impetus due to the appreciation. Not a law of life, not a condition in the physical environment of men, not a pest that may destroy his stores or his comfort, not a product of land, sea or air, but somewhere some one is busy working out details, deducing laws, formulating results, suggesting utilities. The world is *en rapport* with works of this sort, and it is by no means uninformed as to their value. A new law of light, a new application of electric force, a new fact in chemistry, a new method of locomotion, these all are heralded as to an expectant community. The world waits for facts such us these, the world expects them.

The question turns now on the manner in, and the extent to which this tendency is to be recognized in the high school curriculum. It does not need a prophet's vision, nor a sage's wisdom to give the answer. It will be answered on the lines that have reference to the circumstances, duties, and work of life. It were idle to stem the tide even were it desirable. It is not a counter-argument that the term "practical tendency" is accepted at its narrowest meaning— that of bare and specific preparation for professional or business pursuits. But if even such illogical answers should be made, the fact still remains that the high school is the poor man's college. It furnishes the highest education which the major portion of the young men and women of a community can obtain. Who, then, shall say that it should not prepare, not alone for right living, which is solely a subordinate and moral aspect of the question, but for successful business living? Why should not the studies pursued have discipline as a means and utility as an end? We do not believe a thoughtful, intelligent answer can be negative. We ask, then, a modification of the traditional curriculum and the institution — better perhaps to say substitution — of one which has as a prominent feature the culture of today. The time has passed when one ignorant of the laws of health and the gross anatomy of the person, ignorant of the chemistry of cookery and the laws of ventillation, ignorant of the dynamics of physical nature and unlearned as well as unskilled in the manipulations of the laboratory, may pose as a cultured man, though his knowledge of wonderful tongues and skill in rhetorical or literary art be never so great. "What can you do?" not "what do you know?" is the question of the hour, and the high school of to-day and of the future will be compelled to answer the question. Will it do it completely? Not as at present constituted, nor, if like the barrister, it be bound by the law of precedents, will it ever intelligently answer it.

### Relation to University Requirements.

To this phase of the subject attention will be but briefly directed. The high school does not exist for the college or the university; it is an end in itself. Its original institution did not contemplate its relations to these institutions as a gymnasium, but appears to have resulted from the more universal methods of gradation of school work. In cities it was learned that the time required to master the elementary studies could be much shortened by rigid system and rigid enforcement of its necessary provisions. Following this it was discovered that students might complete their school life at too early an age. Additional studies were introduced, and finally a system involving a secondary education, formerly confined to private academies and seminaries, became a part of the public school scheme; the high school became a fact.

There can be no question that popular education did not contemplate the establishment of the high school. To many, and to us, its legal right to exist is questionable. However that may be, the high school has come to stay. It has the support and sympathy of the liberally educated classes, and is not unappreciated by the less fortunate grades in society. So that the problem of its curriculum must be worked out in view of the interest these two classes of society evidence in general education.

At the end of the scheme of public instruction stands the university. Most, if not all, of the States recognize this relationship, and the curriculum of the secondary or high school is devised to conform to it. We think wisely. Recently, in this city, DesMoines, a convention of schoolmasters discussed this, or a nearly related matter, and the opinion at that time expressed evidenced a condition of belief far from unanimity as to the requirements presented by the university authorities. But the university is right in high requirements; right in insisting that secondary instruction be confined to secondary schools; right in assuming that its educational forces are to be exerted along the highest possible lines. Particularly is this true of the requirements in physical science. The proper prosecution of original research, which is certainly a university prerogative, the best presentment of modern scientific thought and method, which is the aim of university education, cannot be realized when its instructors are burdened with quasi-elementary work. So, back upon the high school must fall the work of elementary instruction in physical science. This the university demands, and this the high school must do. Now, in the appointment of the various courses leading to degrees in the universities, it is noticeable, if decade he compared with decade, that more and more are scientific subjects occupying the fore-ground. More time to science, fewer subjects; more stringent requirements, greater opportunity for elections, these are the rule in the modern university and these must be understood and appreciated on the part of the high school. There are few good colleges and no universities of standing which do not now demand at least a year in physics and a year of botany. In most others biological subjects are held as essential, and not a few require a fairly

complete course in physical geography — of all high school subjects the most difficult and the one most commonly poorly taught. Certain universities, as Harvard and Michigan, require elementary chemistry; others entirely omit it, because in it students are too often poorly prepared. Said a university professor of chemistry to me, not long ago, "I prefer my students to come to me with no chemistry. I find they too often come with matter and methods to be unlearned." Now, this must be remedied in the chemistry work of the high school; the "indictment must be quashed;" the fault must be corrected by proper instructions and skilled methods. Without appliances, that is to say, without laboratory facilities, radical and valuable revolution is impossible. Physical science in the high school must be experimental.

Without multiplying words, then, it may be stated that the high school must give, to those who ask it, preparation for entrance into university work. It must adapt its science curriculum to the requirements of the standard college or university. For long years these higher institutions compelled certain and definite work in language and mathematics, they compel that work, with little or no modification to-day. Why cannot they, equally well, compel proper science preparation? We believe they can; we think they will.

There will not be, in the nature of things there cannot be, a set limit to science requirements in the universities. As the tables of the various laboratories, physical, chemical, physiological and biological, become over-taxed, up go the requirements. The standards of entrance are being steadily raised, especially in Indiana University, Michigan University, Cornell, Yale, Harvard, and Leland Stanford, Jr., Universities, as fast as the high and other secondary schools will admit of it. So there is no goal; no end; the high school will ever need to keep close watch on university matters and determine its own work accordingly. Our own State university proposes to the high school to occupy advanced ground in this very matter; to gain and hold the confidence of the university, on the one hand, to meet a legitimate demand for more complete preparation in science on the other, the high school course must be materially modified.

## THE FEEDING OF HORSES.

BULLETIN No. 13 of the Agricultural Experiment Station of Utah has been received. This bulletin reports the results of a feeding trial of horses by the director, J. W. Sanborn. It reports the result of a trial in a direction that the American Experiment Station literature is almost silent upon, viz., feeding horses hay and grain mixed, and feeding cut against whole hay to horses.

It is a common belief with horsemen that when grain, especially meal, and more especially such meal as corn meal, is fed to horses alone or mixed with hay, it tends to compact in the stomach and produce indigestion. It is believed that it so far compacts that the gastric juices do not have free access to the mass of it. Furthermore, it is believed to be subject more to the washing influence of heavy drinking. In the latter respect it is known that the horse's stomach is very small, and that grain is liable to be washed out of it, as the stomach necessarily overflows with water.

As usual, the writer fed two lots of horses for nearly three months, one lot with hay and grain mixed, and the other lot with hay and grain fed separately. At the end of this period the food was reversed, and the horses were fed some two months more. It would be unnecessary to quote the figures of lengthy trial. Suffice it to say that it was found that horses, as in the case of cattle and pigs, showed no disadvantage by the division of the grain and hay into separate feeds over feeding hay mixed with grain. Indeed, in this trial he found a disadvantage for the horses on the hay and grain mixed, they not maintaining their weight as well. The author ascribed this result to the fact that the timothy hay when cut fine, with its sharp solid ends, irritated and made sore the mouths of the horses, and possibly induced too rapid eating, as when the hay and grain were moist they would be more likely to eat more rapidly than when fed dry. As this trial is in accord with trials with ruminants and with the pig, it would seem quite probable that the old and persistent argument in favor of mixing hay and grain is not sound.

The second trial reported in this bulletin covered feeding of cut against whole hay to horses. This trial also covered two periods in which the foods were reversed with the sets, in order to determine whether any change of weights found was due to the individualism of the horses, or whether it was due to the system of feeding. The two periods covered from August 10 to December 31. As in the other case, we will not review the tabulated data that accompany the bulletin. This trial was very decisively in favor of the cut clover for the four months and a half covered by this period. The food fed was clover, and the author points out the fact that clover hay and lucerne, unlike timothy hay, do not present sharp, solid, cutting edges. The results are decisive, and in accordance with those of a trial made by the Indiana Experiment Station with cattle. Director Sanborn points out the fact that these trials, covering nearly a year's time with four horses, showed that horses consume practically the same amount of food that cattle do when high fed, and make it somewhat clear that horses make as economical use of hay and grain as do cattle, and he calls attention to the fact that the practice of charging more for pasturage of horses, where grooming is not involved, is not well founded. He also shows that less food was eaten during the hot months than during the cooler months, and particularly that the horses ate less grain during the hot months than during the cooler months. The trial seems to show also that a rather large ration of grain for work-horses is an economical one.

## NOTES AND NEWS.

THE idea of flower-farming for perfumes seems to be exciting a good deal of interest in New South Wales, as many inquiries on the subject have lately been submitted to the Agricultural Department. There are at present in the colony no means of illustrating the practical operations of this industry, but the *Agricultural Gazette of New South Wales* hopes that this deficiency will soon be supplied by the institution of experimental plots on one or more of the experimental farms. The *Gazette* points out that in scent farms large quantities of waste material from nurseries, gardens, orchards, and ordinary farms might be profitably utilized, while occupation would be found for some who are unfit for hard, manual labor. A Government perfume farm was lately established at Dunolly, in Victoria, and this promises to be remarkably successful.

— At the meeting of the Field Naturalists' Club of Victoria on March 14, as we learn from *Nature*, Professor Baldwin Spencer, the president, gave an interesting account of a trip he had made to Queensland in search of Ceratodus. Special interest attaches to this form, since it is the Australian representative of a small group of animals (the Dipnoi) which is intermediate between the fishes and the amphibia. Ceratodus has its home in the Mary and Burnett Rivers in Queensland, whilst its ally, Lepidosiren, is found in the Amazon, and another relative, Protopterus, flourishes

in the waters of tropical Africa. Although unsuccessful in obtaining the eggs of Ceratodus, owing to the early season, Professor Spencer was able, from a careful study of the surroundings under which the animal lives, to infer that its lung is of as great a service to it during the wet as during the dry season — a theory in direct opposition to the generally accepted one that the lung functions principally during the dry season, when the animal is inhabiting a mud-cocoon within the dry bed of the river.

— A second attempt is to be made to build an observatory at the top of Mont Blanc. As the workmen who tunnelled last year through the snow just below the summit did not come upon rock, M. Janssen has decided that the building shall be erected on the frozen snow. A wooden cabin was put up, as an experiment, at the end of last summer, and in January and early in the spring it was found that no movement had occurred. According to the Lucerne correspondent of the London *Times*, the observatory is to be a wooden building 8 metres long and 4 metres wide, and consisting of two floors, each with two rooms. The lower floor, which is to be embedded in the snow, will be placed at the disposition of climbers and guides, and the upper floor reserved for the purposes of the observatory. The roof, which is to be almost flat, will be furnished with a balustrade, running round it, together with a cupola for observations. The whole building will rest upon six powerful screw-jacks, so that the equilibrium may be restored if there be any displacement of the snow foundations. The building is now being made in Paris, and will shortly be brought in sections to Chamounix. The transport of the building from Chamounix to the summit of Mont Blanc and its erection there have been intrusted to the charge of two capable guides — Frederick Payot and Jules Bossonay.

— Dr. J. Hann laid before the Academy of Sciences at Vienna, on May 5, says *Nature*, another of those elaborate investigations for which he is so well known, entitled "Further Researches into the Daily Oscillations of the Barometer." The first section of the work deals with a thorough analysis of the barometric oscillations on mountain summits and in valleys, for different seasons, for which he has calculated the daily harmonic constituents, and given a full description of the phenomena, showing how the amplitude of the single daily oscillation first decreases with increasing altitude, and then increases again with a higher elevation. The epochs of the phases are reversed at about 6,000 feet above sea-level as compared with those on the plains. The minimum on the summits occurs about 6 A.M., and in the valleys between 3 and 4 P.M. The double daily oscillation shows, in relation to its amplitude on the summits, nearly the normal decrease, in proportion to the decreasing pressure, but the epochs of the phases exhibit a retardation on the summits, of as much as one or two hours. In the tropics, however, this retardation is very small. He then endeavors to show that these modifications of the daily barometric range on mountain summits are generally explained by the differences of temperature in the lower strata of air. In connection with this part of the subject, he considers that even the differences in the daily oscillations at Greenwich and Kew are mostly explained by the different altitudes of the two stations and by the fact that Greenwich is on an open hill. In the second section he has computed the harmonic constants for a large number of stations not contained in his former treatise of a similar nature, including some valuable observations supplied by the Brazilian Telegraph Administration, and others at various remote parts of the globe.

— The last meeting of the Royal Meteorological Society for the present session was held on Wednesday evening, June 15. A paper on "English Climatology, 1881–1890" was read by Mr. F. C. Bayard. This is a discussion of the results of the climatological observations made at the society's stations, and printed in the *Meteorological Record* for the ten years, 1881–1890. The instruments at these stations have all been verified, and are exposed under similar conditions, the thermometers being mounted in a Stevenson screen, with their bulbs four feet above the ground. The stations are regularly inspected and the instruments tested by the assistant secretary. The stations now number about eighty, but there were only fifty-two which had complete results for the ten years in question. The author has discussed the results from these stations and given the monthly and yearly means of temperature, humidity, cloud, and rainfall. His general conclusions are: (1) With respect to mean temperature the sea-coast stations are warm in winter and cool in summer, whilst the inland stations are cold in summer and hot in winter. (2) At all stations the maximum temperature occurs in July or August, and the minimum in December or January. (3) Relative humidity is lowest at the sea-coast stations and highest at the inland ones. (4) The south-western district seems the most cloudy in winter, spring, and autumn, and the southern district the least cloudy in the summer months, and the sea-coast stations are, as a rule, less cloudy than the inland ones. (5) Rainfall is smallest in April, and, as a rule, greatest in November, and it increases from east to west. "The Mean Temperature of the air on each day of the year at the Royal Observatory, Greenwich, on the average of the fifty years, 1841 to 1890" was presented by Mr. W. Ellis, F.R.A.S The values given in this paper are derived from eye observations from 1841 to 1848, and from the photographic records from 1849 to 1890. The mean annual temperature is 49.5°. The lowest winter temperature, 37.2°, occurs on January 12, and the highest summer temperature, 63.8°, on July 15. The average temperature of the year is reached in spring on May 2, and in autumn on October 18. The interval during which the temperature is above the average is 169 days, the interval during which it is below the average being 196 days.

— The Todas, inhabiting the Nilgiri plateau, says *Nature*, are not dying out gradually, as has long been supposed. The last census figures show that they have increased by no less than 10 per cent during the last ten years, there being now nearly eight hundred of them altogether.

— In a recent number of the Journal of the Straits Branch of the Royal Asiatic Society there is an interesting note on the little insectivora, *Tupaia javanensis*. It is very common in Singapore, and especially in the Botanic Gardens, where it may be often seen running about among the trees. It is easily mistaken for the common little squirrel (*Sciurus hippurus*), of which it has much the appearance. When alarmed it quickly darts up the trunk of the nearest tree, but it is a poor climber, and never seems to go high up like the squirrel. Besides these points of resemblance, it appears to be largely frugivorous. It was found that the seeds sown in boxes were constantly being dug up and devoured by some animal, and traps baited with pieces of cocoa-nut or banana were set, and a number of tupaias were caught. These being put into a cage appear to live very comfortably upon bananas, pine-apple, rice, and other such things; refusing meat. The Rev. T. G. Wood, in his "Natural History," states that *T. ferruginea* is said to feed on beetles, but to vary its diet with certain fruits. The common species at Singapore seems to be almost entirely frugivorous, though its teeth are those of a typical insectivora.

— The Mississippi Valley Medical Association will hold its eighteenth annual session at Cincinnati, Oct. 12–14, 1892. An excellent programme, containing the best names in the valley and covering the entire field of medicine, will be presented. An address on Surgery will be delivered by Dr. Hunter McGuire of Richmond, Va., President of the American Medical Association. An address on Medicine will be made by Dr. Hobart Amory Hare, Professor of Therapeutics and Clinical Medicine, Jefferson Medical College, Philadelphia. The social as well as the scientific part of the meeting will be of the highest order. The Mississippi Valley Medical Association possesses one great advantage over similar bodies, in that its organic law is such that nothing can be discussed during the sessions save and except science. All ethical matters are referred, together with all extraordinary business, to appropriate committees — their decisions are final and are accepted without discussion. The constitution and by-laws are comprehensive and at the same time simple. Precious time is not allowed the demagogue or the medical legislator. The officers of the Pan-American Medical Congress will hold a conference at the same time and place. E. S. McKee, M.D., Cincinnati, is the secretary.

# SCIENCE:

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## THE DE LAINCEL FUND FOR THE STUDY OF THE MAYA LANGUAGE AND ITS GRAPHIC SYSTEM.

BY WM. M. AUGNEY.

THE de Laincel Fund, so-named, after a relative, by a gentleman of Philadelphia, now residing in Mexico, who contributes handsomely to its support, has for its object a thorough study of the graphic system of the ancient Mayas, by collecting vocabularies of that language and its dialects, and obtaining reliable artistic reproductions, by means of photographs, of the ancient cities and mural inscriptions of Central America, also photographing and copying ancient manuscripts or other material which will be of service to students in this special field of research.

The work will be carried on under the direction of an advisory committee, to be chosen from among ethnologists who are authorities upon, and students of, the Maya language, its paleography and art.

The exploration of the fund will be carried on under the direction of Dr. Hilborne T. Cresson of Philadelphia, well known as an ethnologist in America and Europe. The result of his researches have at times been published by the Peabody Museum, where for the past five years he has been a special assistant, working under the direction of Professor F. W. Putnam of Harvard University. Dr. Cresson's artistic training at the Ecole des Beaux Arts, in the ateliers of the sculptor Alexander Dumont, and the painter J. Leon Gerome (his works having been exposed in the Salon of 1877), joined to that of an accomplished French and Spanish scholar, especially capacitates him for this line of research. He has also for some years past been studying the Maya language under the direction of so distinguished an authority as Professor Daniel G. Brinton, and a good basis has thus been obtained for future research.

The de Laincel Fund will act in conjunction with some of our leading American institutions, yet to be determined upon, or independently, as its patron may deem best. The work will be carried on during the healthy season in the south, adopting the plan already pursued by other exploring parties — that of carrying out its investigations during those months which are best suited to the sanitary condition of its workers.

Secretary's office, 519 Spruce Street, Philadelphia, June 27.

## CURRENT NOTES ON ANTHROPOLOGY. — IX.

[*Edited by D. G. Brinton, M.D., LL.D.*]

### The Peruvian Languages

Now that the great work of Dr. E. W. Middendorf on the Peruvian languages has been brought to a conclusion by the publication of the sixth and last volume, that on the Muchik (or Chimu or Yunca) tongue, the high value of this contribution to American ethnology should be urged on the scientific world.

Dr. Middendorf is a medical man who practised his profession many years ago in various parts of Peru, making a study of the native dialects his favorite recreation. He thus became practically familiar with them as living tongues, and backed up that knowledge by an acquaintance with such literature as they possessed. The results of this long devotion are now before us in six large octavo volumes, published by Brockhaus, Leipzig, and counting up in all to nearly 2,400 pages of handsomely printed material. The languages considered are the Kechua, the Aymara, and the Chimu, with an appendix on the Chibcha. There is an ample supply of grammatical analyses, texts, phrases, and, of the Kechua, a copius Kechua-German-Spanish dictionary. That the Aymara and Chimu vocabularies are not arranged alphabetically must be regarded as a blemish. One of the volumes contains the original text and a German translation of the drama of Ollanta, believed by many to be a genuine specimen of a native, pre-Columbian, dramatic production. There are also many songs and specimens of prose writings in the same tongue. Taking Middendorf's practical observations along with Tschudi's "Organismus der Kechua Sprache," the student will find himself well equipped to master this interesting idiom.

### The Orientation of Primitive Structures.

The study of the relative directions which the walls and angles of ancient structures bear to the cardinal points has scarcely yet received the attention from archæologists which it merits.

Several varieties of this "orientation," as it is termed, are to be found, each with its own meaning. The ancient Egyptian *mastabas* and pyramids have their sides facing the cardinal points. This arose from the desire of having the door in the centre of the eastern side to face the rising sun, and the western door, *sta*, to face the setting sun, as it was through the latter that the god Anubis conducted the soul to the other world. On the other hand, the Babylonians and Assyrians directed the angles, and not the sides, of their temples to the cardinal points, for what occult reason is not clear. Again, Mr. J. Walter Fewkes has found that the *kib-vas*, or sacred chambers, of the Tusayan Indians at the Moqui Pueblo are oriented north-east and south-west. This he at first thought was owing to the character of the bluff, but there are reasons to believe it of a ceremonial origin.

Some curious observations in this connection are reported by Mr. Robert M. Swan, about the Zimbabwe ruins, in the last number of the *Journal of the Royal Geographical Society*. He found a series of ornaments on the walls of the great temple so disposed that one group would receive directly the sun's rays at his rising and another at his setting at the period of the winter solstice, when these points in that

latitude were respectively 25° south of east and west: while a third series of ornaments faced the full midday sun. Others were similarly arranged for the summer solstice; and a great stone over the temple showed, by alignment with the main altar and a carved pattern on the wall, the true north and south.

Last year an English archæologist undertook a journey to Greece to make a special study of the orientation of the ancient temples on that classic ground, but his results have not yet appeared. Certainly, as will be seen from the above, the point is one full of significance.

### On Prosopology.

There is little doubt that craniology, as a branch of anthropology, has been much over-estimated, and affords only very insecure material for ethnic classifications. On the other hand, the study of the features of the face, which may be called Prosopology, from the Greek, *prosopon*, face, is yielding constantly more valuable results. The width or narrowness of the face, the nasal and orbital indices, the prominence of the jaws, the facial angles, and the development of the chin, all are points of prime ethnic significance.

One of the leading European writers on this subject is Professor Kohlman of Basel, whose works are extremely instructive. In this country a series of papers on "The Ethnology of the Face," by Dr. A. H. Thompson, have appeared in the *Dental Cosmos* for the current year. They place the details of the subject in a popular light, and emphasize its value; but they would be more satisfactory had their author not been led astray by some of the books which he quotes. To class the Eskimos and the American Indians among the Mongolians is quite out of date; and to call the white race Caucasians, and to divide them into blondes and brunettes as leading subdivisions is scarcely less so. He does, indeed, distinguish an "Americanoid" type, from which he excludes the Eskimos and Aleuts as being "true Mongols;" on what grounds he or any one would be puzzled to say. He describes the hair of this "Americanoid" type as similar to that of the Mongolians, from which, in fact, it differs in nearly every respect. In spite of these drawbacks, Dr. Thompson's articles form a welcome and praiseworthy addition to recent American contributions to anthropologic literature.

### Linguistic Bibliography.

The study of American languages will in the future be vastly facilitated by the admirable series of bibliographies by Mr. James C. Pilling, which are now being published by the Bureau of Ethnology. Some idea of their thoroughness may be gained from the fact that the latest issued, confined to the Algonquian dialects alone, has 614 double-columned, closely printed, large octavo pages! Compare this with the 258 pages of Ludewig's "Bibliography of American Aboriginal Literature," which included all the languages of both North and South America!

Mr. Pilling has put forth similar volumes, less in size but not inferior in completeness, on the Iroquois, Eskimo, Dakota and Muskokee groups of tongues; and proposes to lay a similar basis for the study of all the North American stocks. It would be most desirable for some similar catalogue to be made relating to the tongues of South America.

### The Decrease of the Birth-rate.

One of the most portentous problems is the decrease of the birth-rate in certain social conditions. It is asserted on apparently good authority that the Negritos and the Polynesians are dying out, largely owing to the infertility of their marriages. Certain South American tribes, the Guatos of Paraguay, for instance, will soon disappear from the same cause. But we need not confine our instances to savage peoples. Physicians say that our "colonial dames," scions of Anglo-American families who have lived several generations in this country, have much smaller families than their great-grandmothers.

In France this lessening of the birth-rate has assumed serious proportions, and has alarmed patriotic men lest as a nation it should become numerically too weak to hold its own in the conflicts of the future. The distinguished author and statesman, the Marquis de Nadaillac, has published some stirring admonitions to his countrymen on the subject under the titles "Le Peril National and la Depopulation de la France." He finds the birth-rate least in the cities, in the richest communes, and in the most prosperous conditions of society. Turning to its causes, he has convinced himself that this diminution is voluntary and of malice prepense on the part of married couples. They do not want the bother of many children; they do not wish their property to be split up; they prefer pleasure and ease to the labor of parental duties. Young men prefer mistresses to wives, and mistresses are always barren. The competition of modern life and its rabid thirst for enjoyment undermine the family tie. The birth-rate is small, not for physiological but for sociological reasons. How far this applies to the United States has not yet been sufficiently investigated; but it is probably nearly equally true here.

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## THE VARIABILITY OF SPECIFIC CHARACTERS AS EXHIBITED BY THE EXTINCT GENUS CORYPHODON.

BY CHARLES EARLE.

IT is a well-recognized law in biology, that a species or a genus upon the point of extinction undergoes a great amount of variation; and, as an example of this kind, I propose to describe some of the variations which the species of the fossil genus *Coryphodon* exhibit.

The fine collection of Coryphodon material in the American Museum of Natural History has enabled me to study this subject; and in a forthcoming paper in the Bulletin of the Museum I shall attempt a revision of the American species of *Coryphodon*.

The great amount of variation in this genus is shown from the fact that no less than twenty-one species have been described, and only in a few cases have any of them been acknowledged as synonyms.

Taking up the variation of the teeth, I will first describe the structure of a typical upper and lower molar of *Coryphodon*. The superior molars are a modification of the primitive tri-tubercular type, in which the anterior crescent, or antero-external lobe, has been lost, or so much modified that only traces of it remain. On the antero external portion of the crown there is a prominent cone, which is in connection with the single internal lobe by a sharp crest (see Fig. *a*, *c*); this forms the main grinding surface of the tooth. On the second superior molar of a true Coryphodon there is always a well-developed postero-external crescent (see Fig. *e*, *c*), which is homologous with the postero-external crescent of other forms. This crescent may undergo a great amount of variation, as will be described later. In the last superior molar the postero-external crescent is represented by only a crest, which runs parallel, or nearly so,

with the anterior crest already described. As in all the early Eocene-Tertiary Mammalia, the pumolars of both the lower and upper series are much simpler than the true molars. The structure of the lower molars of *Coryphodon* is interesting, as it represents a stage in the modification of a more primitive type, which had the enamel arranged in the form of two symmetrical V's or crescents. Now in *Coryphodon* the anterior limb of each crescent is nearly reduced; this applies especially to the posterior V. The portion of the tooth bearing the anterior V is raised high above the posterior or heel part.

The variation in size of the teeth of the different species of *Coryphodon* is very great, and in not a single instance have I been able to find two individuals, of the same species, whose teeth are of the same size. This variation is shown in the form of the canines and incisor teeth; in the former the difference in size is largely due to age and sex.

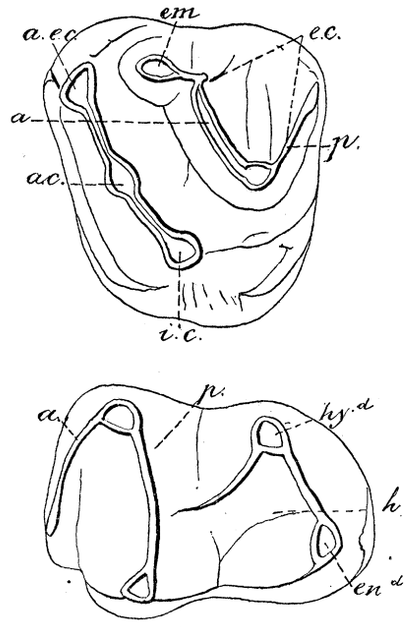
The last upper molar undergoes a great amount of variation, it varying from the nearly quadrate form to that of an elongated oval, the latter form occurring in the more modified species. The modification of the elements of the crown of the second superior molar is interesting, as we can trace in this transformation a true phyletic series, from the less specialized to the more modified species. The typical forms of *Coryphodon* have the external crescent of this tooth well developed. The first step towards reduction of the crescent occurs where the intermediate portion of the posterior limb (see upper Fig. *p*) disappears, leaving an external isolated cusp (*C. testis*). This condition is found permanent on the last superior molar of *Ectacodon*, the latter genus not having advanced so far in its dental evolution as *Coryphodon*. The species *C. elephantopus* represents an intermediate stage in its dental evolution between that of *Coryphodon testis* and *Ectacodon*.

Professor Cope established the genus *Metalophodon* upon the character of the crescent of the second superior molar, and in this genus the posterior limb of the crescent is nearly reduced. As all stages exist in which this crescent is well developed down to that where it is wanting, I can not accept Metalophodon as a good genus, and believe it should be considered a synonym of *Coryphodon*. The most modified condition of this crescent is where it is reduced to merely the anterior limb. The latter stage is permanent in the last upper molar of all the known species of *Coryphodon;* but it is interesting to note that in a genus described by Cope, called *Manteodon*, the last upper molar has a perfectly formed external crescent.

The genus *Manteodon* differs from all other genera of the *Coryphodontidæ* from the fact that the last upper molar has two well-developed internal cones. Now in all other forms of this family the postero-internal cone (*hypocone*) is wanting, although traces of it occur in *C. elephantopus*.

It is not without considerable difficulty that the homologies of some of the elements of the upper molars of *Coryphodon* are determined. The form of molar from which the *Coryphodon* type of tooth has probably arisen, occurs in the genus *Pantolambda*, which is from the Puerco or lowest Eocene beds of New Mexico. In *Pantolambda* both the external crescents of the superior molars are well developed, and the internal cone has two crests running out from it. Now what are the homologies of the anterior portion of the *Coryphodon* molar as compared with that of *Pantolambda*. The postero-external crescent is equally well developed in both forms, but what has become of the anterior crescent in *Coryphodon*, which is so strongly developed in *Pantolambda*? The prominent cusp (see Fig. *e.m.*) on the external face of all the superior molars of *Coryphodon* probably represents the reduced anterior crescent of *Pantolambda*. This is the homology advanced by Professor Cope. The anterior crest of *Coryphodon* has arisen by the development of the crest running outwards from the internal cone of *Pantolambda*. Thus it is by studying the earlier or more primitive types of many of the Mammalian phyla that we are enabled to interpret those marvellous changes which different parts of the dental and skeletal structures have undergone.

The structure of the last lower molar displays considerable variation; this affects particularly the elements of the heel (see lower Fig. *h.*). In the more primitive species the two cusps forming the heel are in a straight line, whereas in other varieties a small cusp may arise in the posterior valley of the heel, internal to the postero-internal cusps (*e*, *n*, *a*). The growth of this rudimentary cusp causes the pushing outwards of the




*A superior and inferior molar of a typical species of Coryphodon (C. radians).* *a. e. c.*, antero-external cone; *a. c.*, anterior crest; *i. c.*, internal cone; *e. m.*, external median cusp; *e. c.*, postero-external crescent; *a.*, anterior limb of crescent; *p.*, posterior limb; *h.*, heel of lower molar; *hy.d.*, external cone of heel; *en.d.*, internal cone.

internal of the two primitive cusps forming the heel; further growth causes the primitive internal cusp to occupy a median position, and it now fulfils the function of a fifth lobe of some of the other Ungulates. This postero-median cusp is merely an analogical structure, and its development proves that it is not homologous with the fifth lobe of the Lophiodonts.

The skeletal variations are many in this group, they affect principally the length and heaviness of the limb bones, and also the size of their articular extremities may vary a great deal.

The variations of the astragalus are particularly interesting, as upon them in some cases new genera have been established. A very primitive structure occurs in the tarsus of *Coryphodon*, as in all the other genera of the *Amblypoda;* that is, on the inner side of the astragalus, a separate bone, or rather a facet for this bone to articulate with, is present. The bone articulating with this facet is generally called the tibiale or internal navicular. Baur[1] has shown that the

[1] American Naturalist, January, 1885, p. 87.

tibiale occurs in the tarsus of the recent genera *Cercolabes* and *Erethizon* as it does in that of *Coryphodon;* therefore the presence of this bone must be considered as one of the primitive characters of the skeleton of this extinct group of Ungulates.

The relations of the tibiale facet to the other facets of the astragalus may vary a good deal, and in many cases the tibiale facet appears to be absent, whereas it is really not separated from the navicular facet of the astragalus.

In conclusion, I wish to add that I was led to write this abstract in order to show the numerous variations of the species of *Coryphodon*, and that in this group it is exceedingly difficult to say where one species ends and another begins. In most cases the characters run into each other so insensibly that it is almost impossible to separate the species. However, I believe there are about eight good species of *Coryphodon* whose characters show a progression from the primitive to the more specialized types; this progression and specialization affecting the teeth more particularly, as already described.

American Museum of Natural History, New York.

## INDIAN NUMERALS.

BY EDWARD F. WILSON.

IN an essay on "The Origin of Languages," published several years ago by Mr. Hale, the idea is suggested that, as, for example, among our native Indians a family may, while hunting or in time of warfare, have chanced to become separated entirely from the rest of the tribe, father, mother, and elder members of the family may all have perished, and two or three little children have been left alone. Such children, Mr. Hale thinks, would gradually invent a new language of their own, retaining, perhaps, a few words or parts of words of their mother tongue. In this manner, he thinks, may be accounted for the remarkable diversity of tongues among the Indians of the Pacific coast, where among the mountains and forests a family might thus easily become isolated, and the comparative oneness of speech on the great central plains of this continent and in such an open country as Australia.

If there is any good foundation for such a theory as the above, we should expect that the old words retained by these young founders of new varieties of speech would be words of the simplest character and those most often in use in the domestic circle. And, indeed, I think we do find that fire, water, I, you, one, two, three, four, five are the words that generally approach the nearest to one another in a comparison of the different vocabularies.

The North American Indians, as a general rule, count by the decimal system, as do most civilized peoples; but it is noticeable that, after giving a distinct name to each figure from one to five, they, in many of the dialects, seem to commence anew with the figure six, the first part of that numeral sometimes being a contraction, or other form, of the numeral one, and the latter part of the word seeming to point on towards ten. Thus, in the Ojebway we have (1) pejig, (2) nij, (3) niswi, (4) niwin, (5) nanăn, (6) ningodwaswi, (7) nijwaswi, (8) nishwaswi, (9) shangaswi, (10) midaswi. It will be noticed here that from six to ten inclusive the termination is *aswi*. *Ningo*, with which six begins, is another form of pejig (1) never used alone, but only in composition, thus: ningo-gijik, one day; ningo-tibaiigan, one measure. In the Cree language (another Algonkin dialect) the first ten numerals are as follows: (1) peyăk, (2) niso, (3) nisto, (4) né·o, (5) niya'năn, (6) nikotwasik, (7) tepakŭp, (8) ayena'new, (9) keka mita'tat, (10) mita'tat. Here it will be noticed that these Cree numerals resemble those of the Ojebways from one to six, but with seven they branch out into distinct words; then with ten they come together again, mita'tat not being dissimilar to midas'wi, and still more like midatching, the Ojebway equivalent for "ten times." Neither is the Cree numeral for nine so unlike that of the Ojebways as might at first sight appear. Keka mita'tat means "nearly ten," and this suggests that the Ojebway word shangaswi may mean the same, chegaiy or chig' being the Ojebway for near.

The reason for the decimal system being so prevalent all over the world, both among civilized and barbarous people, is doubtless the fact that human beings are possessors of ten fingers, five on each hand. The common manner of counting among the Indians is to turn down the little finger of the left hand for one, the next finger in order for two, the next for three, the next for four, and the thumb for five; then the thumb of the right hand for six, and so on until the little finger of the right hand is turned down for ten. In indicating numbers to others, the left hand held up with all the fingers turned down except the little finger would mean one; that and the next finger to it held up would mean two and so on. In counting by tens they will close the fingers of each hand to indicate each ten, or they will hold both hands up with the palms outward and fingers extended for each ten.

Some Indian tribes in counting resort to their toes as well as their fingers, and thus follow the vigesimal system. The Indians of Guiana, it is said, call five a hand, ten two hands, and twenty a man.

The Dakotas have a peculiar system of their own. When they have gone over the fingers and thumbs of both hands, one finger is temporarily turned down for *one ten*. At the end of the next ten another finger is turned, and so on to a hundred. Opawinge, one hundred, is derived from pawinga, to go around in circles, to make gyrations.

Indians are not generally good arithmeticians. In their native state they have no idea of making even the simplest mental calculation. To add or subtract they will use sticks, pebbles, or other such objects.

To illustrate the manner in which various tribes (some of them of different stocks) count from ten upwards, examples are herewith given from the Ojebway, Blackfoot, Micmac, and Dakota languages: With the Ojebways 10 is midaswi; 11, 12 are midaswi ashi pejig, midaswi ashi nij; 20, 30 are nij-tana, nisimidana; 21, nij-tana ashi pejig; 100, ningodwak; 101, ningodwak ashi pejig. With the Blackfeet 10 is kepo; 11, 12, kepo nitsiko'poto; 20, 30, natsippo, niippo; 100, kepippo. With the Micmacs 10 is mtŭln; 11, 12, mtŭln tcel na-ukt, mtŭln tcel tabu; 20, 30 are tabu inskääk, nasinskääk; 21, tabu inskääk tcel na-ukt; 100, kŭskimtŭlnakŭn; 101, kuskimtŭlnakŭn tcel na-ukt. With the Dakotas (or Sioux) 10 is wiktcemna; 11, 12, wiktcemna sanpa wanjidan (10 more one), wiktcemna sanpa nonpa; 20, 30 are wiktcemna nonpa (ten two), wiktcemna yamni; 21, wiktcemna nonpa sanpa wanjidan (ten two more one); 100 is opawinge, meaning a circle.

In some of the Indian languages there is more than one set of the cardinal numbers. Animate objects may be counted with one set, inanimate with another. They may have a particular set for counting fish or for counting skins; perhaps a set for counting standing objects, and another set for counting sitting objects, etc.

To give a few instances in the Ojebway tongue: nanan, 5; nanominag, 5 globubar, animate objects, as turnips, seeds, etc.; nanonag, 5 boats or canoes; nanoshk, 5 breadths of cloth; and nanoshkin, 5 bags full (nūshkin meaning full); nanosag, 5 things of wood; nanwabik, 5 things of metal. In the Zimshian language (Brit. Columbia) guel means one if the object is neŭter, gaul, if masculine or feminine, gouuz-gŭn, when the thing is long like a tree or pencil, ga'at, if a fish or animal is spoken of, gŭmmet, if applied to a canoe; the other numerals change in the same way.

It is interesting to note that in the Ainu, the aboriginal language of Japan, a distinction is made in the numeral according as the object spoken of is animate or inanimate, thus: shinen, one person; shinep, one thing; tun, two persons; tup, two things.

Sault Ste. Marie, Ontario, June 22.

## BLACK KNOT.

BULLETIN No. 40 of the New York State Experiment Station at Geneva (Peter Collier, director) contains a valuable summary of our present knowledge concerning this pest, from which the following is abstracted: —

The "Black Knot" is a disease of plums and cherries, which causes the formation of a hard, rough, black, wart-like surface on an enlarged or distorted outgrowth of the bark. The following statements, furnished by Mr. P. Groom Brandow of Athens, Green County, N.Y., indicate the former extent and value of the plum industry in that region and its total devastation by the Black Knot.

He states that, beginning at Cedar Hill, about four miles below Albany, the plum district included a belt about three miles on each side of the river and extended southward about thirty-six miles to Germantown. He began setting plums for a commercial orchard in 1861, and at one time had six thousand trees. Two of his neighbors each had about two thousand trees, and most of the farmers went into the business to a greater or less extent. It was no uncommon thing for a steamer to carry from one hundred to five hundred barrels of plums to New York at one trip. For four days' picking in one week he received $1,980. In 1884 he netted $8,000 from his plums, and the next year he rooted out over five thousand trees on account of the Black Knot. From twenty-five hundred young trees two to three years old, left at that time, he thinks he has not yet realized over $250.

It was formerly believed that Black Knot was produced by some gall insect, and it is not strange that this opinion prevailed on account of the gall-like character of the knots and the fact that they are frequently infested by insects. Some believed it to be the work of the curculio, others thought that it was not the curculio, but some other insect or cause that produced the knots. But several years ago Dr. W. G. Farlow published, in the first annual report of the Bussey Institute, the results of his investigations, which proved conclusively that the Black Knot is caused solely by a parasitic fungus which grows within the bark, and which is now known to science by the name of Plowrightia morbosa. It is recognized as growing on cultivated cherries, and also on the wild red or yellow plum, the Chicasaw plum, the choke-cherry, the wild red cherry, and the wild black cherry. It is commonly most destructive to the plum, but also seriously attacks the cherry.

The external appearance of the mature form of the Black Knot is generally well known. It appears at this stage as a rough, wart-like excrescence, or distorted outgrowth, from the bark of twigs and branches, and in severe cases may extend along the trunk for several feet. The first outward sign of the formation of a new knot is seen in a swelling of the tissue within the bark either in the fall or during the growing season of the tree. The swelling increases till the bark is ruptured, and over the surface thus exposed the fungus sends out numerous threads (hypæ), which produce a velvety appearance and are of an olive-green color. Microscopic examination of the velvety surface reveals multitudes of newly formed and forming spores borne on these upright threads. These spores (conidia) are called summer spores. When full grown they drop off from the supporting threads, and when carried by winds, insects, or other agencies, to another host-plant, under favorable conditions they may start growth and form a new centre of disease, from which in time other trees may also be infested, and thus spread the disease from tree to tree and neighborhood to neighborhood.

The best way to deal with thoroughly infested trees is to cut them down and burn them at once, thus insuring the destruction of the spores before they spread the disease any further. Trees not badly infested may be treated by cutting off affected branches some distance below the knot. This operation is best performed in the fall immediately after the foliage drops, because the winter spores are not formed at that time and consequently there is less danger of their being disseminated in the operation, and also because the work can be done more thoroughly when there are no leaves to hide the knot. The summer spores must also be taken care of in their season. As soon as there is any indications of the formation of a new knot, in the spring or during the summer, the branch on which it occurs should be cut and burned. The first outbreak will probably be noticed about the middle of May.

It is important to note that if a branch containing the knot be cut from the tree and thrown on the ground, the spores will ripen in due time just the same. Therefore the practice of collecting carefully and burning every knot cannot be too strongly urged.

The bulletins of the Massachusetts Experiment Station contain some experiments in the application of various substances for the purpose of destroying the knot. Kerosene, turpentine, linseed oil, sulphate of copper, and a mixture of red oxide of iron and linseed oil are mentioned among the substances tried. These seem to be effective in destroying warts to which they are applied to saturation, but care must be used with the turpentine and kerosene or the entire branch will be killed.

## LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

*The editor will be glad to publish any queries consonant with the character of the journal.*

*On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.*

### A Plea for the Study of Psychology.

THE perusal of a report, written by a member of the visiting committee of one of our universities, induced me to write these lines. In the course of the report, the remark is made that the study of psychology is difficult, and therefore few students take the study. The importance and advantage derived from studying a subject are to be considered more than its difficulty. Its usefulness is determined by its educational value; and surely there is no subject of study more useful and beneficial than psychology; for all persons who deal with people require a knowledge of this subject.

Since psychology has been taken out of the field of metaphysics, and has entered the domain of the natural sciences, it has developed marvellously. The accuracy and stability it has attained are proportionate to its development. Biology has brought about this change. The former position psychology occupied was not so much to determine the relation and connection between mind and organism as to determine the science of pure thought. But now psychologists have studied the brain, anatomists have dissected the cerebral lobes, chemists have analyzed the different substances of the nerves and brain, and its size, weight, shape, and specific gravity have been taken into account for the sole purpose of determining psychical phenomena; also the laws of development have been applied to the phenomena of the human mind. The study of animal instinct, the growth of children, the customs, habits, and beliefs of early tribes and races, the study of defectives, the study of the brain and the senses and the logical connections of ideas, have all received their share of attention. There is no psychical phenomenon and no act of human conduct which does not come within the province of psychology. The sciences of ethics, of theology, of law, of jurisprudence, of history, of medicine, of pedagogy, and of politics presume a knowledge of the workings of the human mind. For who, unless competent to analyze correctly and justly the feelings, desires, and motives that prompt action, would desire to determine the motives that underlie human conduct or pass upon the laws of right and wrong. How much more humane would a person be in his judgment upon the acts and conduct of another if he knew the causes of them. How many mistakes would be avoided in the training and education of the young, if parents and teachers were more conversant with the principles of psychology. How much more accurate could judges be in dispensing justice, if they were less dependent upon their personal experience, and knew more about the principles of psycology. What material aid could lawyers give in establishing the truth, if they were well versed in the study of psychology. How many grave blunders could be avoided, if statesmen and legislators understood more thoroughly the spirit of the times and the popular mind.

That the larger portion of professional men know little, if anything, about psychology cannot be denied, and if they do know something about the study, their knowledge is either founded on their personal experience and on common maxims, or it is derived from some book written from some particular standpoint. Most of such knowledge is incorrect and wrong, and it is one of the objects of psychology to correct these false notions.

In conclusion, I will quote John Stuart Mill, who has given an excellent statement of the reasons why psychology should be studied. He says: "Psychology, in truth, is simply the knowledge of the laws of human nature. If there is anything that deserves to be studied by man, it is his own nature and that of his fellow-men; and if it is worth studying at all, it is worth studying scientifically so as to reach the fundamental laws which underlie and govern all the rest. There are certain observed laws of our thoughts and our feelings, which rest upon experimental evidence, and, once seized, are a clue to the interpretation of much that we are conscious of in ourselves, and observe in one another. Such, for example, are the laws of association. Psychology, so far as it consists of such laws, is as positive and certain a science as chemistry, and fit to be taught as such."

FRANKLIN A. BECHER.

Milwaukee, Wis.

## Ball-Lightning.

DURING a severe thunderstorm yesterday the phenomenon of ball-lightning was seen in this village. An inspection of the locality shows that the ball was located between a telephone wire and a conductor-pipe about three feet distant, and was doubtless of the nature of an electrical brush preceding the disruptive discharge. It was of a reddish color, and exploded with a report like a musket; but did no damage, nor was it attended by any smell perceptible to those who saw it, although they were distant not more than five feet. M. A. VEEDER.

Lyons, N. Y., June 28.

## BOOK-REVIEWS.

*Animal Coloration.* By FRANK E. BEDDARD. 8°. New York, Macmillan & Co.

IN the opinion of the writer the most concise and useful treatise upon the important subject of animal coloration has very recently appeared from the presses of Macmillan & Co. Its author, Mr. Frank E. Beddard, F.R.S., is especially favorably known in this country, among morphologists, through his numerous and admirable publications which have appeared in connection with his duties as prosector to the Zoological Society of London. That position, coupled with the fact that Mr. Beddard has made extensive collections of materials to illustrate his "Davis Lectures" on the subject of which his present volume treats, is ample evidence that he was peculiarly well fitted to deal with the subject. The work, a small octavo of some 300 pages, is gotten up with all that exquisite taste and style which has long ago made the house of the Macmillans so justly famous. Many excellent wood-cuts and several beautiful, colored lithographic plates illustrate its pages, they being especially devoted to giving striking examples of "protective coloration" among animals, as well as "protective mimicry," "sexual coloration," "warning coloration," "coloration as affected by environment," and numerous kindred topics. Completing the volume, we find a well-digested "General Index," and an "Index of Authors' Names." Among the latter we note those of many laborers in this country, and it is gratifying to see that America's work along such lines is upon the constant increase, and from year to year meets with enhanced favor. Our author, in his "Introductory," clearly defines the distinction between "Color" and "Coloration," the former being the actual tints which are found in animals, the latter simply referring to their arrangement or pattern. Of course, the terms become synonymous in uni-tinted animals. "The colours of animals are due either solely to the presence of definite pigments in the skin, or, in the case of transparent animals, to pigment in the tissues lying beneath the skin; or, they are partly caused by optical effects due to the scattering, diffraction, or unequal refraction of the light rays." Other matters more or less remotely bearing upon this part of the subject are briefly, though ably, dealt with, nothing of importance having been overlooked. Mr. Beddard has not remained satisfied with drawing upon any special class or group of animals for illustration, but has carried his investigations into all nature, touching in the most brilliant manner upon the significance of the colors and coloration of "deep sea forms," "cave animals," and indeed plant and animal growths from all parts of the globe. Nor has he omitted to discuss the theories of various other authorities than those advanced by himself; in short, the entire subject covered by this highly inviting field of research seems to be brought fully up to date, and in many instances the book even extends our knowledge. Biologists everywhere will thank Mr. Beddard for this contribution, and its modest price ($3.50) will constitute no real barrier to its soon appearing upon the shelves of every working naturalist in the United States.

R. W. SHUFELDT.

Takoma, D.C.

## AMONG THE PUBLISHERS.

A NEW work on astronomy, entitled in "Starry Realms," has recently come from the press of J. B. Lippincott Company. The object of the work is to give the general reader some sketches of specially interesting matters relating to the heavenly bodies. The opening chapters are devoted to the more important relations of the sun to the earth, in which the author illustrates the different functions which the sun performs. The moon's history, and the phenomena attendant upon the lunar world, the planets, the meteors, the stars, are also ably considered. The work is embellished with ten full-page illustrations, and others in the text.

— Beginning with the July number, the magazine hitherto known as *Babyhood* will bear the name of *The Mother's Nursery Guide*, which expresses its purpose more fully and clearly than did the old appellation. There is no other change discernable in the essential features of the magazine, which looks back upon a

prosperous past of nearly eight years. The July number contains a summary, by the medical editor, of the present status of the question of milk sterilization, concerning the value of which the last word has not yet been said. "Baby's Flannels" forms the subject of another medical paper.

— The new edition of "Chambers's Encyclopædia" is rapidly nearing completion, and with the advent of one more volume this standard reference book will be at the command of all who are desirous of procuring a most accurate, convenient, and useful encyclopædia. The ninth volume has just been issued. Among the more important American articles are found San Francisco, St. Louis, St. Paul, Scandinavian Mythology, Sir Walter Scott, Sewage, Sewing Machine, Shakers, Shakespeare, Shelley, Phil. Sheridan, Sherman, Ship-Building, Silk, Silver, Slang, Soda, South Carolina, Spain, Sugar, Spiritualism, etc. These are all copyrighted, as are also the articles by American authors in all the volumes issued. The maps of this number include Russia, Scotland, South Australia, Spain, and South Carolina, prepared according to the latest geographical surveys. "Chambers's Encyclopædia" is never disappointing, its articles are well up to date, and a large number of entirely new subjects are introduced. The illustrations are incomparably the best ever issued in a work of this character. The volumes contain on an average nearly a thousand pages each. Volume X. will be issued in the fall. J. B. Lippincott Company are the American publishers.

— Messrs. Joseph Baer & Co., booksellers, Frankfort, are selling the botanical library of the late Professor L. Just, director of the botanical garden connected with the Polytechnicum at Carlsruhe. The list includes many important works in various departments of botanical science.

— In 1874 the British Association published a volume of "Notes and Queries on Anthropology," the object being to promote accurate anthropological observation on the part of travellers, and to enable those who were not anthropologists themselves to supply information wanted for the scientific study of anthropology at home. A second edition has long been wanted and a committee was appointed by the British Association to consider and report on the best means for bringing the volume up to the requirements of the present time. The committee recommended that the work should be transferred to the Anthropological Institute, and this proposal was accepted, the Association making grants amounting to £70 to aid in defraying the cost of publication. The new edition has now been issued, according to *Nature*, the editors being Dr. J. G. Garson and Mr. C. H. Read; and everyone who may have occasion to use it will find it thorough and most suggestive. The first part — Anthropography — has been entirely recast; the second part — Ethnography — has been revised, and additional chapters have been written. Among the contributors to the volume are Mr. F. Galton, Mr. A. W. Franks, Dr. E. B. Tylor, General Pitt-Rivers, and many other well-known authorities.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For information address Mr. FRITZ RUHL, President of the Societas Entomologica, Zurich-Hottingen, Switzerland.

## NEO-DARWINISM AND NEO-LAMARCKISM.

By LESTER F. WARD.

Annual address of the President of the Biological Society of Washington delivered Jan. 24, 1891. A historical and critical review of modern scientific thought relative to heredity, and especially to the problem of the transmission of acquired characters, The following are the several heads involved in the discussion Status of the Problem, Lamarckism. Darwinism, Acquired Characters, Theories of Heredity, Views of Mr. Galton, Teachings of Professor Weismann, A Critique of Weismann, Neo-Darwinism, Neo-Lamarckism, the American "School," Application to the Human Race. In so far as views are expressed they are in the main in line with the general current of American thought, and opposed to the extreme doctrine of the non-transmissibility of acquired characters.

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For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g. to 1-10mg.), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete [illegible], 1862-1885 (62-71 bound); Smithsonian Reports, 1854-1883; U. S. Coast Survey, 1854-1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

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To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

### *Wants.*

*Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head* FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

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WANTED.—We want any and all of the following, providing we can trade other books and magazines or buy them cheap for cash: Academy, London, vol. 1 to 28, 35, Jan. and Feb., '89; Age of Steel, vol. 1 to 66; American Antiquarian, vol. 1, 2; American Architect, vol. 1 to 6, 9; American Art Review, vol. 3; American Field, vol. 1 to 21; American Geologist, vol. 1 to 6; American Machinist, vol. 1 to 4; Art Amateur, vol. 1 to 7, Oct., '4; Art Interchange, vol. 1 to 9; Art Union, vol. 1 to 4, Jan., '44, July, '45; Bibliotheca Sacra, vol. 1 to 46; Godey's Lady's Book, vol. 1 to 20; New Englander, vol. 11; Zoologist, Series 1 and 1, Series 3 vol. 1 to 14; Allen Armendale (a novel). Raymer's "Old Book" Store, 243 4th Ave. S., Minneapolis, Minn.

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— The Open Court Publishing Co., Chicago, has just ready a second edition, revised and enlarged, of Gen. M. Trumbull's timely book on the tariff question, "The Free-Trade Struggle in England."

— Charles L. Webster & Co. announce that they will issue in book form Mr. Poultney Bigelow's Danube articles describing his canoe voyage down that river, the title of the book being "Paddles and Politics Down the Danube."

— In *Lippincott's Magazine* for July "Peary's North Greenland Expedition and the Relief" is well and interestingly covered by W. E. Hughes and Benjamin Sharp. Gertrude Atherton contributes a short essay on "Geographical Fiction."

— Charles H. Sergel & Co., Chicago, have just issued in their series of Latin-American Republics "A History of Peru," by Clements R. Markham, which gives a complete history of the country from the conquest to the present time. They have in press for the same series "A History of Chile," by Anson Uriel Hancock; and in active preparation "A History of Brazil," by William Eleroy Curtis; "A History of Argentine," by Mary Aplin Sprague; and "A History of Bolivia," by T. H. Anderson, U. S. Minister to Bolivia.

— Macmillan & Co. have just ready "The Barren Ground of Northern Canada," by Warburton Pike, with maps.

— Chain & Hardy Co., Denver, Col., have just ready a little pamphlet, entitled "Review of Ore Deposits in Various Countries," by Rudolf Keck, of Colorado Springs, Col.

— G. P. Putnam's Sons have just ready an important work on "The English Language and English Grammar, being an historical study of the sources, development and analogies of the language and of the principles governing its usages, illustrated by copious examples from writers of all periods," by Samuel Ramsey; the fifth and concluding volume of the "Memoirs of Talleyrand;" "Earth-Burial and Cremation," a history of earth-burial with its attendant evils, and the advantages offered by cremation, by Augustus G. Cobb, formerly President of the U. S. Cremation Society and Vice-President of the New York Cremation Society.


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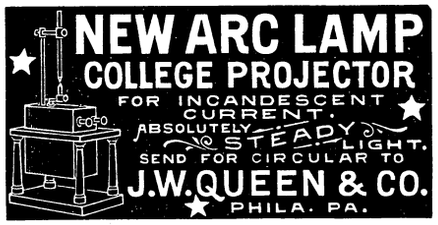


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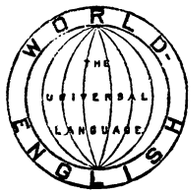


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Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Botanical Laboratory, A.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cercopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School of Applied Science.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diphtheria, Tox-Albumin.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Hemoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, The New Method of Protecting Buildings from.
Lissajou's Curves, Simple Apparatus for the Production of.
Maize Plant, Observations on the Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Some Recent, in the State of Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
Patent Office Building, The.
Physa Heterostropha Lay, Notes on the Fertility of.
Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
Psychological Laboratory in the University of Toronto.
Psychological Training, The Need of.
Psylla, the Pear-Tree.
Rain-Making.
Rivers, Evolution of the Loup, in Nebraska.
Scientific Alliance, The.
Sistrurus and Crotalophorus.
Star Photography, Notes on.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

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